

What is claimed:

1 1. A method for manufacturing a semiconductor device, the method comprising
2 the steps of:

3 (a) forming a gate dielectric layer;

4 (b) forming a first conduction layer on the gate dielectric layer;

5 (c) forming a first upper layer comprising a material different from the first
6 conduction layer on the first conduction layer;

7 (d) forming a second upper layer comprising a material different from the first upper
8 layer on the first upper layer

9 (e) forming sidewall spacers on side walls of the first conduction layer, the first
10 upper layer and the second upper layer;

11 (f) forming an insulation layer that covers the second upper layer and the sidewall
12 spacers;

13 (g) planarizing the insulation layer until an upper surface of the second upper layer is
14 exposed;

15 (h) removing the second upper layer;

16 (i) removing the first upper layer to form a recessed section between the sidewall
17 spacers; and

18 (j) forming a second conduction layer in the recessed section to form a gate electrode
19 that includes at least the first conduction layer and the second conduction layer.

1 2. A method for manufacturing a semiconductor device according to claim 1,
2 wherein the step (h) is conducted by an etching method, and in the step (h), a ratio of an
3 etching rate of the second upper layer with respect to an etching rate of the first upper layer
4 is two or greater.

1 3. A method for manufacturing a semiconductor device according to claim 1,
2 wherein the step (i) is conducted by an etching method, and in the step (i), a ratio of an
3 etching rate of the first upper layer with respect to an etching rate of the first conduction
4 layer is two or greater.

1 4. A method for manufacturing a semiconductor device according to claim 1,
2 wherein the first upper layer is formed from silicon nitride and the second upper layer is
3 formed from polysilicon.

1 5. A method for manufacturing a semiconductor device according to claim 1,
2 further comprising, after step (i), forming a barrier layer between the first conduction layer
3 and the second conduction layer.

1 6. A method for manufacturing a semiconductor device according to claim 1,
2 further comprising, after step (i), forming a barrier layer between the first conduction layer
3 and the second conduction layer, and forming the barrier layer between the second
4 conduction layer and the sidewall spacers.

1 7. A method for manufacturing a semiconductor device, the method comprising
2 the steps of:

3 (a) forming a gate dielectric layer;

4 (b) forming a first conduction layer on the gate dielectric layer;

5 (c) forming an upper layer on the first conduction layer, at least a lower portion of
6 the upper layer comprising a material different from at least an upper portion of the first
7 conduction layer;

8 (d) forming sidewall spacers on side walls of the first conduction layer and the upper
9 layer;

10 (e) forming an insulation layer that covers the upper layer and the sidewall spacers;

- 11 (f) planarizing the insulation layer until an upper surface of the upper layer is
12 exposed;
- 13 (g) removing the upper layer to form a recessed section between the sidewall spacers
14 on an upper portion of the first conduction layer; and
- 15 (h) forming a second conduction layer in the recessed section to form a gate
16 electrode that includes at least the first conduction layer and the second conduction layer.

1 8. A method for manufacturing a semiconductor device according to claim 7,
2 wherein the step (g) is conducted by an etching method, and in the step (g), a ratio of an
3 etching rate of at least the lower portion of the upper layer with respect to an etching rate of
4 the at least upper portion of the first conduction layer is two or greater.

1 9. A method for manufacturing a semiconductor device according to claim 7,
2 wherein the first conduction layer is formed from a polysilicon layer.

1 10. A method for manufacturing a semiconductor device according to claim 7,
2 wherein the second conduction layer comprises a material selected from the group
3 consisting of a metal, a metal alloy and a metal compound.

1 11. A method for manufacturing a semiconductor device according to claim 7,
2 further comprising, after step (g), forming a barrier layer between the first conduction layer
3 and the second conduction layer.

1 12. A method for manufacturing a semiconductor device according to claim 7,
2 further comprising, after step (g), forming a barrier layer between the first conduction layer
3 and the second conduction layer, and forming the barrier layer between the second
4 conduction layer and the sidewall spacers.

13. A method for manufacturing a semiconductor device, the method comprising:
forming a gate dielectric layer;
forming a first conduction layer on the gate dielectric layer;
forming an upper layer on the first conduction layer, the upper layer comprising a material different from that of the first conduction layer;
forming sidewall spacers on side walls of the first conduction layer and the upper layer;
removing the upper layer to form a recessed section between the sidewall spacers and above at least part of the first conduction layer; and
forming a second conduction layer in the recessed section to form a gate electrode comprising the at least part of the first conduction layer and the second conduction layer.

1 14. A method for manufacturing a semiconductor device according to claim 13,
2 further comprising, after step (g), forming a barrier layer between the first conduction layer
3 and the second conduction layer.

1 15. A method for manufacturing a semiconductor device according to claim 13,
2 further comprising, after step (g), forming a barrier layer between the first conduction layer
3 and the second conduction layer, and forming the barrier layer between the second
4 conduction layer and the sidewall spacers.

1 16. A method for manufacturing a semiconductor device according to claim 13,
2 wherein the first conduction layer and second conduction layer comprises materials having
3 different compositions.

1 17. A method for manufacturing a semiconductor device according to claim 13,
2 wherein the first conduction layer comprises polysilicon and the second conduction layer
3 comprises a material selected from the group consisting of a metal, a metal alloy and a metal
4 compound.

1 18. A semiconductor device comprising:
2 a field effect transistor, the field effect transistor including a gate dielectric layer, a
3 gate electrode, sidewall spacer regions, a source region, and a drain region, wherein
4 the gate electrode includes a first conduction layer and a second conduction layer,
5 the first conduction layer is formed on the gate dielectric layer,
6 the second conduction layer is formed above the first conduction layer,
7 the sidewall spacer regions are formed on side walls of the gate electrode,
8 an insulation layer is provided adjacent to the sidewall spacer regions, and
9 a barrier layer is provided between the first conduction layer and the second
10 conduction layer and between the second conduction layer and the sidewall spacer.

1 19. A semiconductor device comprising:
2 a field effect transistor, the field effect transistor including a gate dielectric layer, a
3 gate electrode, sidewall spacers, a source region, and a drain region, wherein
4 the gate electrode includes a first conduction layer and a second conduction layer,
5 the first conduction layer is formed on the gate dielectric layer,
6 the second conduction layer is formed above the first conduction layer,
7 the sidewall spacers are formed adjacent to side walls of the gate electrode, and
8 an insulation layer is provided adjacent to the sidewall spacers, wherein an upper
9 surface of the insulation layer and an upper surface of the second conduction layer are
10 substantially at the same level.

1 20. A method for manufacturing a semiconductor device according to claim 18,
2 wherein the first conduction layer is formed from a polysilicon layer.

1 21. A method for manufacturing a semiconductor device according to claim 18,
2 wherein the second conduction layer comprises at least one material selected from the group
3 consisting of a metal, a metal alloy and a metal compound.